Aggregate Report AR86-2

Aggregate Resources in the Rural Municipality of Shellmouth

By H.D. Groom

Manitoba
Energy and Mines
Mines Branch

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Winnipeg, 1987

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Map AR86-2: Aggregate resources in the R.M. of Shellmouth ..... in pocket

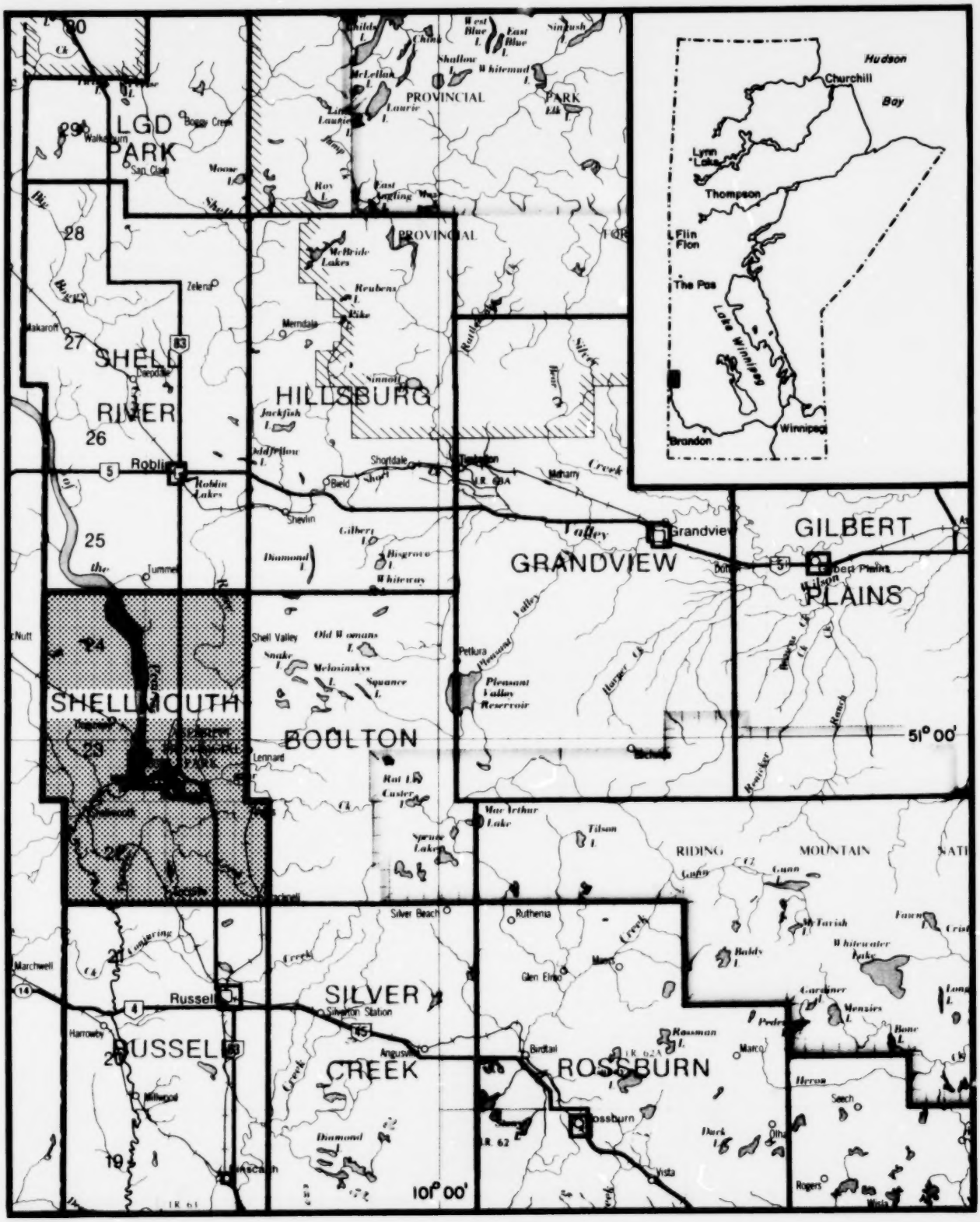

FIGURE 1: Location map of the R.M. of Shellmouth

INTRODUCTION

OBJECTIVES

Mapping in the Rural Municipality of Shellmouth was carried out in order to: 1) delineate the sand and gravel resources at a scale of 1:50 000; and 2) provide an estimate of the aggregate reserves in the municipality. The information is used to facilitate land-use planning designed to protect high quality aggregate deposits from sterilization and to provide aggregate users with resource information.

LOCATION AND ACCESS

The R.M. of Shellmouth covers 560 km^2 in Twps. 22 to 24, Rges. 28 and 29W (Fig.1). The area is primarily a farming district and the village of Inglis is the major service centre. Assessippi Provincial Park lies within the municipality and is a major recreational site for the vicinity.

A network of paved highways and gravelled section roads provides good access to most deposits.

PHYSIOGRAPHY

The municipality lies within the Assiniboine River Plain west of the Manitoba Escarpment. The land has an overall southwest slope. Elevations decrease from 575 m a.s.l. (above sea level) in the northeastern corner of the municipality to 492 m a.s.l. in the southwest. Local relief is subdued on the till plain underlying the northern and central portions of the municipality but commonly exceeds 3 m on the outwash plain that lies east of the town of Shellmouth. Relief exceeds 10 m in the area of a braided esker complex situated south of Shell River (see Fig. 3).

Assiniboine River and Shell River are the major drainage channels in the area. Both are underfit streams occupying valleys that are up to 1.5 km wide and from 60 to 75 m deep. The valley walls are cut into glacial drift and slumping is common only along the northern portion of the Assiniboine River. Construction of the Shellmouth Dam has created the Lake of the Prairies in the Assiniboine Valley north of the dam. Assiniboine River, south of the dam, occupies a wide flood plain covered with fine grained alluvium. There are numerous oxbow lakes on the valley floor. Shell River occupies a relatively narrow flood plain that is bounded on both sides by low-level terrace deposits.

METHODOLOGY

Surficial deposits were delineated on 1:50 000 scale airphotos. Airphoto interpretation was based on surficial units delineated by Klassen (1979) and incorporated information from gravel pit inventory files of the Department of Highways and Transportation Services.

During field mapping, all gravel pits were visited; undeveloped gravel deposits were backhoed either with the landowner's permission or along public road allowances. Samples were taken from deposits considered to be of economic value and analyzed for grain size distribution and petrography.

Pebble counts were carried out on the 4-16 mm fraction of each sample. The pebbles were divided into crystalline (primarily of Precambrian age) and carbonate lithologies. When present, shale was separated from the other lithologies and a visual estimate of the per cent shale per total sample was made.

All gravel deposits were delineated on 1:15 850 scale photos and then transferred to 1:50 000 scale airphotos. The latter were used to produce the 1:50 000 scale map accompanying this report (Map AR86-2, in pocket) and to calculate the area of each deposit. Deposit reserves were obtained by multiplying area by proven gravel depths; sterilization and depletion factors were taken into account.

Detailed information for each aggregate deposit and sample grain size data are available through the Aggregate Resources Section computer system.

PREVIOUS WORK

The surficial geology of the area has been mapped at a scale of 1:250 000 and the glacial history outlined by Klassen (1966, 1979) as part of a regional study of the Riding Mountain-Duck Mountain area of southwestern Manitoba. The evolution of the Assiniboine Spillway and terrace development along the river has also been studied by Klassen (1975).

The soils of the area, including parent material, have been mapped by Ehrlich et al. (1956, 1959), at a scale of 1 inch to 2 miles.

The bedrock geology has been described by Bannatyne (1970). A map of the bedrock topography at a scale of 1 inch to 8 miles has been produced by Klassen et al. (1970).

ACKNOWLEDGEMENTS

Robyn Magas provided able field assistance, M. Carvalho drafted the map and figures, and the Word Processing Centre typed the manuscript. The manuscript was reviewed by members of the Aggregate Resources Section.

GEOLOGY

BEDROCK GEOLOGY

The study area is underlain by Upper Cretaceous marine shales of the Riding Mountain Formation (Fig. 2). The upper member, the Odanah, is a hard, grey, siliceous shale and underlies the southeastern portion of the study area. The lower member, the Millwood, is a soft, greenish, bentonitic shale which forms the bedrock surface of the remainder of the municipality. Depth to bedrock is in excess of 100 m throughout most of the area but rises to near surface in the southeast where it outcrops along Thunder Creek (Klassen et al., 1970).

SURFICIAL GEOLOGY

The generalized surficial geology of the municipality is shown in Figure 3.

With the exception of the river valleys and the outwash plain east of Shellmouth, the municipality is underlain by a rolling till plain. The till, of the late Wisconsinan Lennard Formation, was deposited by the last glacial ice to advance down the Assiniboine River plain. The outwash lying south of the confluence of the Shell and Assiniboine Rivers was deposited during a pause in the retreat of this ice from the area. The position of the ice front at that time is marked by the coarse gravel deposits lying along the northwestern edge of the plain.

The outwash plain covers 26 km^2. The surface is hummocky in the northern and western portions where the plain is underlain by gravel and gently rolling to the south where it is underlain by sand. The sand is predominantly massive or plane bedded; crossbedding is rare. Paleoflow direction in the crossbedded sand is to the west and southwest.

Shell River, carrying meltwater from stagnating ice on the Duck Mountain uplands, flowed at first across the outwash plain and later into the Assiniboine Spillway south of the ice front as this channel deepened enough to confine the meltwater flow. The northern segment of the Assiniboine Spillway was excavated as the ice retreated from the study area. The Assiniboine Spillway continued to carry meltwater from the western prairies to Lake Agassiz after the Shell River channel had ceased to function.

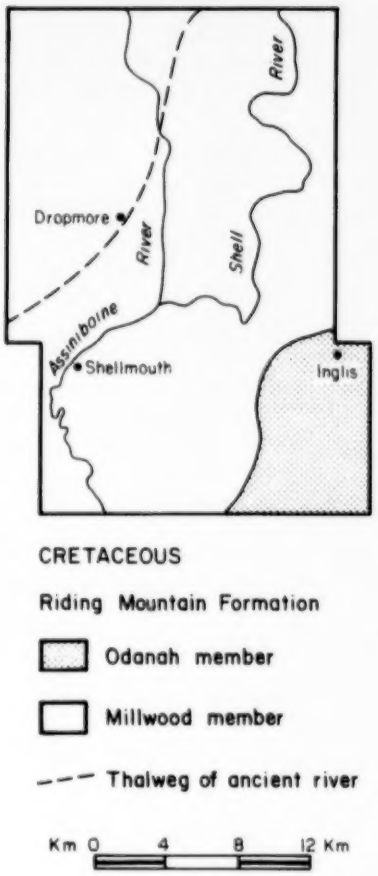

FIGURE 2: Bedrock geology of the R.M. of Shellmouth..

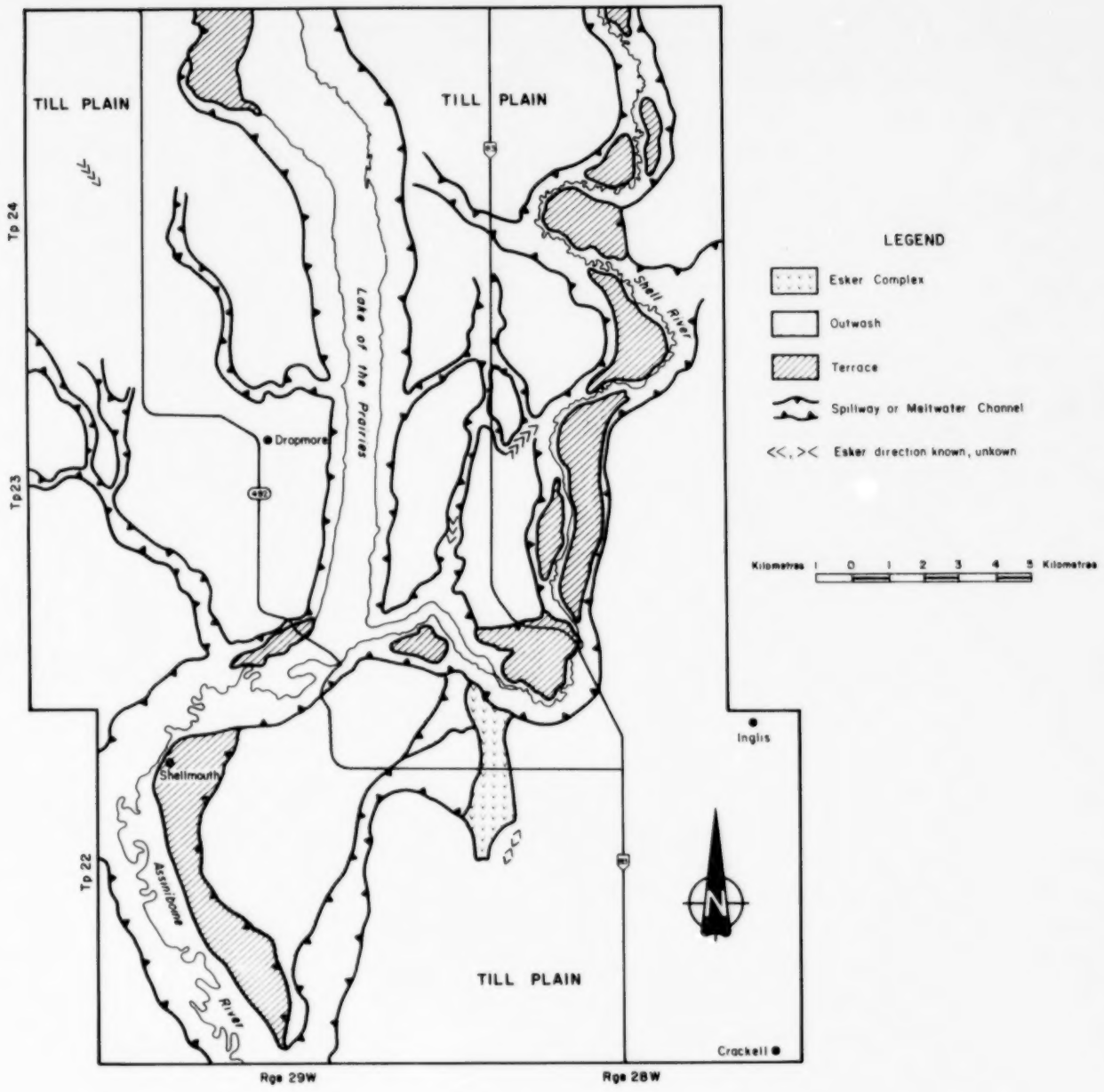

FIGURE 3: Generalized surficial geology of the R.M.of Shellmouth; modified after Klassen, 1979.

AGGREGATE RESOURCES

INTRODUCTION

The sand and gravel reserves of the R.M. of Shellmouth are found primarily in fluvial terraces along the Assiniboine and Shell River spillways and in a large outwash plain south of the confluence of these two rivers. Minor quantities of gravel are found in ice-contact and meltwater channel deposits scattered across the municipality. In the following section, the aggregate deposits are grouped according to type and the groups are discussed in the order presented on Map AR86-2 (in pocket).

Deposit locations are also shown on Map AR86-2. Appendix A summarizes relevant information for each of the deposits. Grain size data are given in Appendix B. The size limits of granular descriptive terms (e.g. sandy fine pebble gravel) used throughout the text are given in Appendix C. Figure D-1 shows the areas of crown gravel within the municipality.

AGGREGATE DEPOSITS

Ice-contact deposits: map unit 1b

Ice-contact deposits, kames and eskers, account for 5% of the aggregate reserves in the municipality.

The bulk of these reserves is found in a large braided esker complex (deposit 14419) lying south of Shell River in Sec. 5-23-28W and Secs. 30 and 31-22-28W. The complex trends north-south. At the northern end, the esker ridges are more than 10 m high and sharp crested. They are formed of a minimum of 4 m of sandy, coarse pebble gravel with cobbles but fine rapidly southwards to fine pebble gravel. The gravel is crossbedded and very well sorted. Backhoe sites in the material flanking the major ridges show 2 to 3 m of pebble gravel overlying fine sand. At the southern end of the complex, the ridges are broad crested and 3 to 4 m high. They comprise sand and pebbly sand; the flanking material is medium-fine sand.

The amount of shale in the gravel is between 3 and 5% in the 4-16 mm fraction. One small pit (NE31-22-28W) is used on an intermittent basis but otherwise the deposit is not used as an aggregate source.

The core of the esker ridge forming deposit 14428 (Fig. 4) contains a minimum of 4 m of cobbly coarse gravel. Shale in the 4-16 mm pebble fraction ranges from 1 to over 10%. The deposit has not been mined for aggregate.

Deposit 14430 contains more than 4 m of sandy fine pebble gravel. The ridge fines to sand southward. Shale ranges from 10 to 25% in this deposit. However, a small pit (SW17-23-28W) is worked intermittently.

Outwash plain deposits: map unit 2b

The outwash plain has been mapped as unit 2a where it is composed entirely of sand and as unit 2b where it is formed of sand and gravel. Deposit 14412, the sand and gravel portion of the plain, contains estimated aggregate reserves of 27 million m^3. The coarsest gravel is found along the northwestern edge of the plain where there is a minimum of 4 m of sandy, coarse pebble gravel with cobbles. The northern end of the deposit is composed of sandy pebble gravel. There are several large pits in Secs. 35 and 36-22-29W where 3 to 4 m of crossbedded fine pebble gravel overlies sand. Backhoe test pits in the central portion of the plain show the same relationship although the thickness of the gravel beds thins to 1 to 2 m (Fig. 5). Gravel depths in the southwestern portion of the deposit ranges between 3 and 9 m and the material ranges from very sandy, fine pebble gravel to cobbly coarse pebble gravel.

The northeastern portion of the plain has been extensively mined and two large gravel pits (HG 851 and HG 841 in 36-22-29W) were active during the summer of 1985. The southwestern part of

FIGURE 4: Esker ridge in Sec. 28-23-28W; deposit 14428

FIGURE 5. Sandy pebble gravel overlying sand in central portion of outwash plain; NE 28 22 29W. Trowel is 28 cm long.

the deposit has been mined in the past and one pit (HG 838 in NW21-22-29W) is used on an intermittent basis. Except for sites HG 449 and HG 481, shale forms less than 2% of the gravel in this deposit.

Terrace deposits: map unit 3b

Terrace deposits, occurring along Shell River and Assiniboine River, contain estimated gravel reserves of 32 million m^3. All the terraces comprise sand and gravel and the thickness of most deposits exceeds the 4 m reach of the backhoe test pits. The material in the deposits ranges from cobble gravel to sand. The amount of shale in these deposits is as much as 5%. Ironstone concretions and carbonate encrustation form secondary deleterious materials in the gravels.

Due to the flooding of the Assiniboine valley north of the Shellmouth dam, only three terrace deposits are exposed along Assiniboine River in the municipality. At the northern end of deposit 14402 an active pit (HG 800 in NW34-24-29W) exposes 5 m of crossbedded sandy pebble gravel. Much of the southern end of the deposit is covered by sand and silt of alluvial fan origin. Deposit 14413 has several gravel pits used on an intermittent basis. The deposit is coarsest in the northeast (Secs. 32 and 33-22-29W), where there is a minimum of 4 m of coarse cobble gravel, and generally fines to the south. The active pit in NW29-22-29W (HG 850) shows 10 m of crossbedded gravel that ranges from fine pebble to coarse pebble gravel (Fig. 6); test pits in SE29-22-29W expose 4 m of interbedded sand and fine pebble gravel. The deposit is partially sterilized by the town of Shellmouth.

The terraces along Shell River are of very large areal extent; several are greater than 2 km^2. The material forming the terraces ranges from cobble gravel to fine sand. Most of the terraces have small pits that are used on an intermittent basis and four deposits - 14420, 14422, 14424 and 14425 - have large pits that have been recently active.

Deposit 14420 has an active pit (HG 830 in SE9-23-28W) which exposes 7 m of sandy fine pebble gravel overlain by 1 m of

FIGURE 6. Active gravel pit (HG 850) in deposit 14413; NW 29 22 29W.

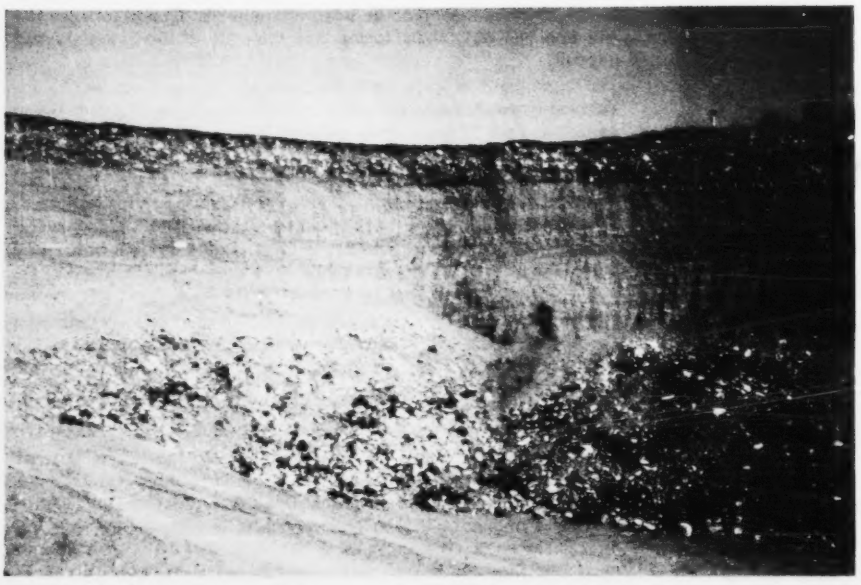

FIGURE 7: Active pit (HG 830) in deposit 14420; SE 9-23-28W. Pit face is 8 m high.

massive cobble gravel (Fig. 7). Test pits in the lower terrace level of this deposit show more than 3 m of pebble gravel overlain by less than 1 m of sand.

The southern part of deposit 14422 is underlain by at least 8 m of interbedded fine and coarse pebble gravel: a backhoe test pit in the bottom of a 6 m deep gravel pit (HG 825 in NE15-23-28W) was stopped by a boulder layer 2 m below the pit floor.

The lowest terrace level of deposit 14424 is primarily sand in the north; less than 3 m of fine pebble gravel overlies sand in the south. The upper terrace levels are underlain by boulders and cobbles (Fig. 8) in the northwest and more than 4 m of interbedded sand, pebble gravel and cobbles in the south. One pit in this deposit (NW11-24-28W) is used intermittently.

Deposit 14425 (Fig. 9) has one large pit and several smaller ones. The pits in the upper terrace level are largely depleted but more than 6 m of pebble gravel is exposed in the active pit (HG 811 in NW23-24-28W) in the lower terrace level. The gravel becomes coarser to the southeast of this pit (test pits show more than 3 m of cobbly coarse pebble gravel) and finer to the southwest where a small pit exposed 3.5 m of fine pebble gravel overlying pebbly sand.

FIGURE 8: Bouldery surface of upper terrace level of deposit 14424. Backhoe penetrated 1.5 m of bouldery cobble gravel before being abandoned without reaching the bottom of the unit.

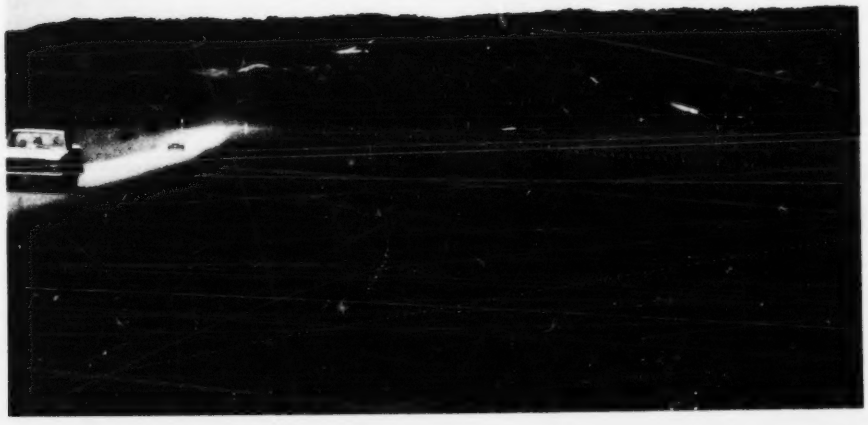

FIGURE 9: Shell River terrace deposit (14425). Note revegetated pit on right side of photo.

Meltwater channel deposits: map unit 4b

Meltwater channels are common in the northwestern portion of the municipality. They are usually from 0.2 to 0.5 km wide, 1-3 m deep and are often sand and gravel floored (Fig. 10). Aggregate deposits associated with meltwater channels account for 6% of total aggregate reserves in the municipality. The thickest gravel deposits occur as bars on the inside of meander curves. These deposits are generally 2 to 3 m of sandy fine pebble gravel and sand overlying till.

Deposit 14407 has unusually thick deposits of gravel all along its length. Test pits in the northern part (Secs. 3 and 10-24-29W) show more than 3 m of sandy fine pebble gravel whereas the active pit in NE35-23-29W (HG 806) is 8 m deep. The gravel is coarser in the south, containing a cobble fraction that is not present at the northern end of the deposit. Shale content ranges from 0 to 4% in the 4-16 mm fraction.

SUPPLY AND DEMAND

In excess of 65 million m^3 of aggregate resources are present within the municipality. Table 1 shows the relative amounts of ag-

FIGURE 10: Meltwater channel, looking south along channel axis; NW 3-24-29W; deposit 14407.

gregate per deposit type. These figures do not include the areas of sand shown on the map (units 1a, 2a, 3a and 4a).

TABLE 1
AGGREGATE RESERVES IN THE R.M. OF SHELLMOUTH

Deposit Type	Reserves (000's m^3)
Terrace	32 407
Outwash plain	26 956
Meltwater channel	4 380
Kames and eskers	3 849
TOTAL	67 547

The outwash and terrace deposits contain both the largest reserves of, and, in general, the highest quality aggregate in the area. The amount of shale in these deposits ranges from nil up to 8% (see table in Appendix A). While the deposits with high shale are unsuitable for certain products such as asphalt or concrete, the aggregate in the outwash and terrace deposits is suitable for most other end uses.

The demand for aggregate by the R.M. of Shellmouth and the Department of Highways for use within the municipality is estimated at 10 000 m^3 annually. The total annual demand is higher than this as companies such as Russell Redi-Mix export gravel outside the municipality for their own use. The aggregate comes from privately owned pits and figures relating to amount removed are unavailable.

However, as in excess of 65 million m^3 of aggregate reserves occur within the municipality, there should not be any shortage of gravel within the foreseeable future. At present, the major sources of aggregate are deposits 14412, 14413, 14420 and 14425. Active pits are also present in deposits 14402, 14407 and 14431.

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APPENDIX A

AGGREGATE DEPOSITS IN THE R.M. OF SHELLMOUTH

DEPOSIT NUMBER	GENETIC TYPE	SAMPLE NUMBER	% STONE (+ #4) (+ 4.76 mm)	LITHOLOGY[1] 4-16 mm % CRYSTALLINE	% CARBONATE	% ESTIMATED[2] SHALE CONTENT	ESTIMATED RESERVES 000's m^3	COMMENTS
14401	Kame		-	-	-	-	72	1.5 m of very sandy fine pebble gravel
14402	Terrace	HG800	42	57	43	2	6 128	1 recently active pit; deposit is generally greater than 4 m of sandy pebble gravel with cobbles; high percentage of ironstone concretions
		HB400	72	46	54	0		
		HB401	69	39	61	0		
		HB405	64	47	53	0		
		HB406	68	49	51	< 1		
		HB411	65	49	51	< 1		
14403	Esker	HB417	51	50	50	< 1	86	1.5 m sandy pebble gravel
14404	Kame	HG801	52	42	58	< 1	62	1 revegetated pit; 2 m pebble gravel
14405	Kame	-	-	-	-		15	2 m sandy fine pebble gravel over till
14406	Meltwater channel	HG802	58	39	61	1	351	1 active pit; less than 3 m very sandy fine pebble gravel
14407	Meltwater channel	HG806	32	46	54	4	3 027	1 large pit, intermittent usage; several small revegetated pits at southern end of deposit; greater than 3 m sand, fine pebble gravel in northern and central portions
		HB421	30	54	46	0		
		HB422	35	48	52	3		
14408	Meltwater channel	-	-	-	-	41		1 revegetated pit
14409	Meltwater channel	-	-	-	-	43		1.5 m sandy fine pebble gravel over clay
14410	Meltwater channel	HG809	52	48	52	< 1	674	1 pit intermittent usage; greater than 3 m sandy pebble gravel thinning to northwest
		HB431	42	48	52	3		
14411	Terrace-	-	-	-	-		381	very deep extensive pits; almost depleted
14412	Outwash plain	HG836	47	53	47	2	26 956	2 large active pits; several small pits used on intermittent basis; gravel thickest in southwest; deposit is hummocky in north and cental portions with gravel occurring in hummocks overlying sand; site 449 is 5% shale in 4-16 mm fraction; site 481 is 8%; all others less than 2%
		HG837	50	51	49	< 1		
		HB838	55	52	48	< 1		
		HG839	65	56	44	< 1		
		HG841	62	53	47	< 1		
		HG842	70	50	50	1		
		HG851	66	52	48	0		
		HB446	57	48	52	1		
		HB449	22	50	50	5		

APPENDIX A (CONT'D)
AGGREGATE DEPOSITS IN THE R.M. OF SHELLMOUTH

DEPOSIT NUMBER	GENETIC TYPE	SAMPLE NUMBER	% STONE (+ #4) (+ 4.76 mm)	LITHOLOGY[1] 4-16 mm % CRYSTALLINE	% CARBONATE	% ESTIMATED[2] SHALE CONTENT	ESTIMATED RESERVES 000's m^3	COMMENTS
		HB461	38	54	46	1		
		HB468	60	45	55	2		
		HB474	57	56	44	0		
		HB475	47	46	54	0		
		HB481	29	50	50	8		
		HB482	43	56	44	1		
14413	Terrace	HG850	27	53	47	7	4 022	2 active pits: deposit depth variable from 2 to 18 m; gravel very coarse along north and western portions; site 850 is 8% shale in 4-16 mm fraction; all others less than 3%
		HB442	49	46	54	3		
		HB444	53	54	46	3		
		HB445	54	52	48	< 1		
		HB471	63	41	59	4		
		HB472	49	53	47	< 1		
		HB476	58	53	47	1		
		HB477	45	47	53	1		
14414	Terrace	HB457	40	53	47	< 1	1 285	3 m sandy pebble gravel in south; gravel fines and thins to north
14415	Terrace	HG847	96	39	61	3	135	revegetated pits; deposit almost depleted
14416	Esker-	-	-	-	-		48	predominantly sand
14417	Meltwater channel	-	-	-	-		81	1 pit, intermittent usage
14418	Kame	-	-	-	-		71	predominantly sand
14419	Esker	HB531	21	43	57	3	2 805	greater than 4 m sandy coarse pebble gravel in north: gravel fines and thins to south
		HB533	44	-	-	5		
		HB539	33	46	54	5		
14420	Terrace	HG830	46	43	57	5	6 600	1 pit intermittent usage, several revegetated pits: gravel greater than 8 m deep in upper terrace: gravel overlain by1-2 m sand on lower terrace: 2 m cobbly pebble gravel overlies finer gravel along eastern edge of deposit
		HG831	73	42	58	< 1		
		HG832	41	51	49	2		
		HG833	54	46	54	3		
		HG834	57	50	50	0		
		HB487	67	39	61	1		
14421	Terrace	HG828	89	46	54	6	690	cobbly pebble gravel: relatively high shale content (up to 8%)
		HB492	60	47	53	8		
14422	Terrace	HG825	67	46	54	2	779	1 pit intermittent usage: greater than 5 m sandy pebble gravel in south: deposit boulder strewn to north
		HB525	62	51	49	0		

APPENDIX A (CONT'D)
AGGREGATE DEPOSITS IN THE R.M. OF SHELLMOUTH

DEPOSIT NUMBER	GENETIC TYPE	SAMPLE NUMBER	% STONE (+ #4) (+ 4.76 mm)	LITHOLOGY[1] 4-16 mm % CRYSTALLINE	% CARBONATE	% ESTIMATED[2] SHALE CONTENT	ESTIMATED RESERVES 000's m^3	COMMENTS
14423	Terrace	HG817	31	46	54	0	3 033	deposit coarsest along northwest edge: variable sand and pebble gravel in southern and central portions; 2 revegetated pits
		HG820	39	49	51	3		
		HG821	43	50	50	1		
		HB511	42	46	54	5		
14424	Terrace	HG816	39	46	54	4	7 845	1 pit intermittent usage: upper terrace very coarse in north, fines to cobbles and pebble gravel in south; lower terrace, pebble gravel overlain by sand
		HB514	51	49	51	0		
		HB516	59	-	-			
		HB519	52	-	-			
		HB520	36	47	53	1		
14425	Terrace	HG811	73	48	52	< 1	1 335	3 pits intermittent usage; greater than 6 m sandy fine pebble gravel, deposit fines to southwest; cobble gravel along southeast edge
		HG813	67	48	52	< 1		
14426	Terrace	HG815	65	48	52	0	174	2 m sandy coarse pebble gravel
14427	Esker	HG822	63	34	66	1	173	large inactive pit on west side of road; overlain by 10 m till
14428	Esker	HG823	95	57	43	1	411	ridge is greater than 4 m of variable cobble and pebble gravel: 499 is 10% shale
		HB499	34	41	59	10		
		HB501	35	39	61	< 1		
14429	Meltwater channel	HG827	35	45	55	3	163	1 revegetated pit; 2.5 m sandy fine pebble gravel
14430	Esker	HG826	9	50	50	> 30	61	less than 3 m sandy fine pebble gravel; ridge south of road is sand; very high shale
		HB497	27	51	49	11		
14431	Buried channel	HG819	18	47	53	0	45	1 active pit: gravel overlain by 4 m of till
					TOTAL RESERVES		67 592	

[1] excluding shale

[2] shale content estimated visually, by volume in the 4-16 mm fraction:

APPENDIX B

GRAIN SIZE DISTRIBUTION OF AGGREGATE SAMPLES FROM THE R.M. OF SHELLMOUTH

DEPOSIT NUMBER	SAMPLE NUMBER	% PEBBLES 4-64 mm	% GRANULES 2-4 mm	% SAND .06-2 mm	% SILT & CLAY < .06 mm	CRUSHABLE ON SITE > 15 cm x Yes
14402	HG800	42.1	25.3	29.6	3.0	x
	HB400	71.9	12.7	13.7	1.7	x
	HB401	69.0	13.8	15.3	1.9	x
	HB405	63.7	14.5	16.6	5.2	x
	HB406	67.6	21.3	9.3	1.8	
	HB411	64.6	16.4	16.7	2.3	
14403	HB417	50.7	22.9	22.5	3.9	
14404	HG801	52.1	23.7	22.0	2.2	
14406	HG802	58.4	18.0	18.6	5.0	
14407	HG806	32.0	24.5	40.1	3.4	x
	HB421	30.3	39.8	27.2	2.7	
	HB422	35.4	32.4	30.5	1.7	
14410	HG809	52.0	25.4	19.4	3.2	x
	HB431	41.7	26.0	30.0	2.3	x
14412	HG836	46.8	14.5	34.0	4.7	x
	HG837	49.5	18.1	30.5	1.9	
	HG838	54.7	25.4	18.6	.3	x
	HG839	65.3	12.3	21.5	.9	
	HG841	61.9	14.0	22.9	.2	
	HG842	69.8	14.5	14.4	1.3	x
	HG851	66.2	8.0	24.8	1.0	x
	HB446	57.2	21.0	17.7	4.1	
	HB449	22.0	15.4	59.3	3.3	
	HB461	38.2	10.1	49.5	2.2	x
	HB468	60.1	9.3	28.2	2.4	x
	HB474	57.1	22.5	18.1	2.3	x
	HB475	47.0	14.5	36.2	2.3	x
	HB481	28.9	19.3	49.4	2.4	x
	HB482	42.6	21.8	33.9	1.7	x
14413	HG850	27.0	28.2	44.5	0.3	x
	HB442	49.1	18.8	30.1	2.0	x
	HB444	52.9	17.0	27.7	2.4	x
	HB445	54.2	19.2	24.2	2.4	x
	HB471	63.1	18.4	16.0	2.5	x
	HB472	48.8	15.7	32.9	2.6	x
	HB476	58.4	23.1	16.9	1.6	x
	HB477	45.0	31.6	21.2	2.2	x
14414	HB457	40.3	21.2	36.3	2.1	x
14415	HG847	95.7	1.7	2.5	0.1	x
14419	HB531	20.5	18.9	59.3	1.3	
	HB533	44.2	22.8	31.0	2.0	
	HB539	32.9	25.4	39.8	1.9	

APPENDIX B (CONT'D)

GRAIN SIZE DISTRIBUTION OF AGGREGATE SAMPLES FROM THE R.M. OF SHELLMOUTH

DEPOSIT NUMBER	SAMPLE NUMBER	% PEBBLES 4-64 mm	% GRANULES 2-4 mm	% SAND .06-2 mm	% SILT & CLAY < .06 mm	CRUSHABLE ON SITE > 15 cm x Yes
14420	HG830	46.3	23.5	29.0	1.2	
	HG831	72.6	9.4	17.1	0.9	x
	HG832	41.4	16.8	40.0	1.8	x
	HG833	54.4	16.6	27.1	1.9	x
	HG834	57.1	16.7	24.8	1.4	x
	HB487	66.7	16.3	15.1	1.9	x
14421	HB828	88.6	3.9	6.8	0.7	x
	HB492	59.9	10.0	26.9	3.2	x
14422	HG825	67.1	14.0	14.5	4.4	x
	HB525	61.8	15.3	21.3	1.6	x
14423	HG817	30.8	18.6	48.8	1.8	
	HG820	38.7	10.3	32.0	19.0	x
	HG821	43.1	9.2	32.0	15.7	x
	HB511	42.1	14.6	42.0	15.7	x
14424	HG816	38.7	23.2	36.2	1.9	x
	HB514	51.3	24.9	18.1	5.7	x
	HB516	58.8	13.5	25.4	2.3	x
	HB519	51.9	18.1	26.7	3.3	x
	HB520	36.3	26.7	34.4	2.6	x
14425	HG811	72.8	11.4	13.5	2.3	x
	HG813	66.6	14.5	16.2	2.7	x
14426	HG815	64.9	8.5	24.5	2.1	x
14427	HG822	63.4	20.6	14.0	2.0	x
14428	HG823	95.0	2.0	2.7	0.3	x
	HB499	34.3	19.1	44.0	2.6	x
	HB501	35.4	14.7	40.3	9.6	
14429	HG827	34.8	18.0	28.1	19.0	x
14430	HG826	8.6	15.8	72.8	2.8	
	HB497	27.2	27.0	43.7	2.1	
14431	HG819	18.3	9.9	45.8	26.0	

APPENDIX C

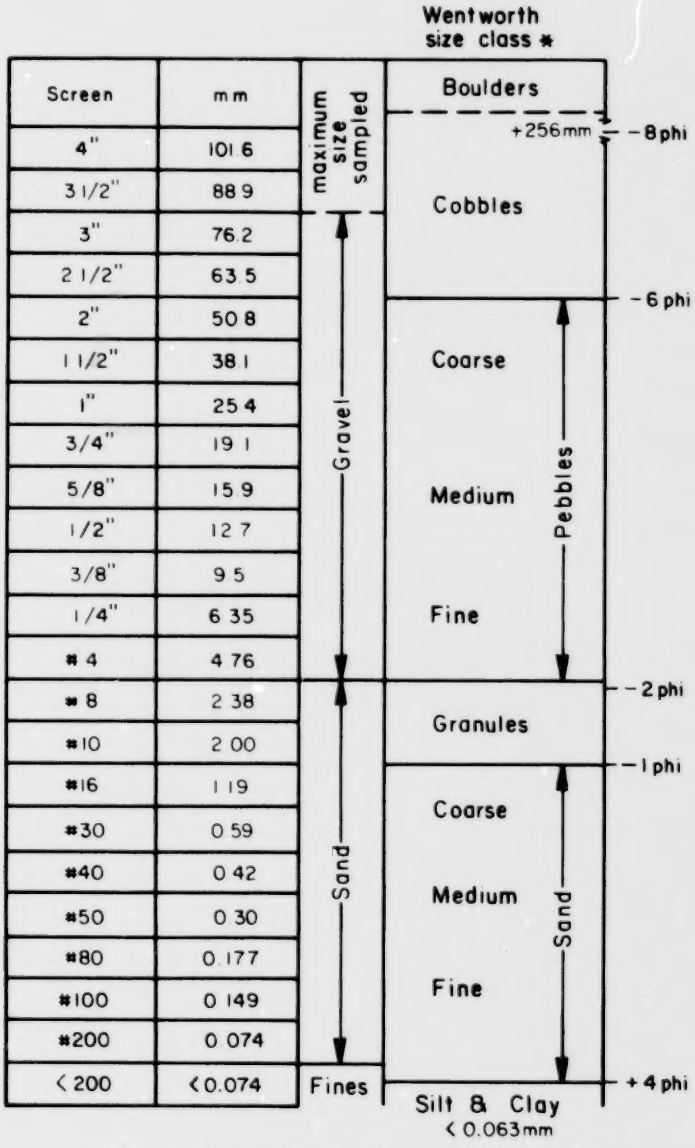

FIGURE C-1: Grain size classification

APPENDIX D

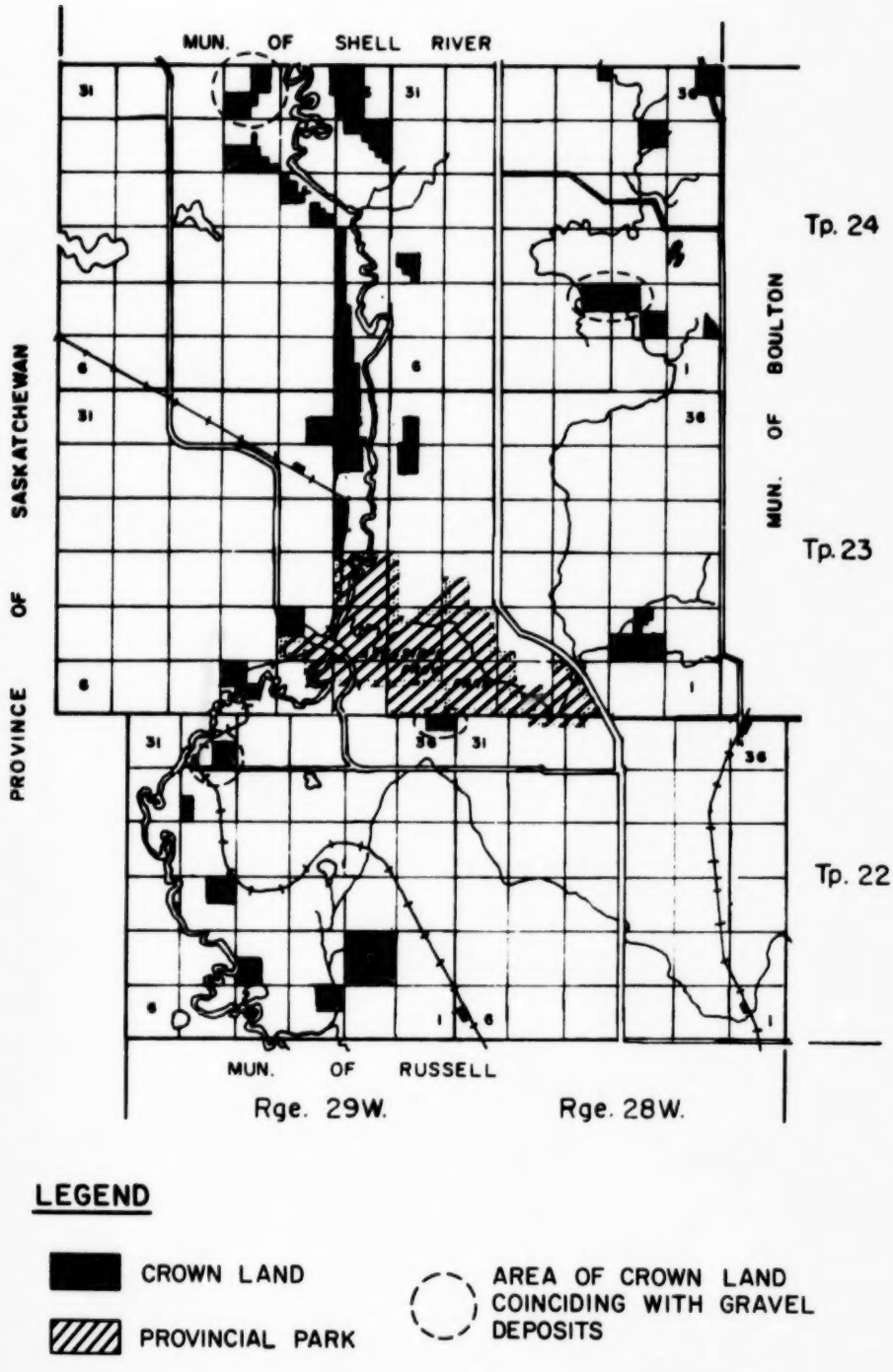

FIGURE D-1: Crown lands in the R.M. of Shellmouth. Circled areas indicate Crown owned gravel; modified from Hince et al., 1987.

APPENDIX E
GLOSSARY

AGGREGATE

Any inert, construction material (sand, gravel, slag, crushed stone or other mineral material).

AGGREGATE RESERVES

Aggregate in a deposit which is proven and is economically signficiant.

ALLUVIUM

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream.

BEACH DEPOSITS

These are relatively narrow, linear features formed at the shores of glacial lakes that existed during deglaciation. Well developed beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates.

BEDROCK

In-place pre-Quaternary material exposed at the surface or underlying the surficial material.

BINDER

Material that produces or promotes consolidation in loosely aggregated sediments. Usually mud or clay, sometimes till is used for binder.

CARBONATE ROCKS

A broad term referring to those sedimentary rocks consisting chiefly of carbonate minerals, mainly limestone and dolostone.

CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a large rock mass. Synonyms include particle and fragment.

CROWN LAND

Land reserved and administered by the Crown. Sand and gravel usually administered by the Crown.

CROWN SAND AND GRAVEL

Sand and gravel reserved and administered by the Crown.

DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly.

DEPOSIT

An accumulation of sediments left in a new location by a natural transportative agent such as water, wind, ice, or gravity.

An aggregate deposit is a deposit of sand and gravel considered to be of economic significance.

DIRT

See fines.

DOLOMITE (DOLOSTONE)

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolomite is also known as dolostone).

DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

DURABLE ROCK

A rock fragment which is hard and inert and can be used as aggregate without breaking, crumbling or reacting with the cementing material.

EOLIAN

Pertaining to wind action.

EPOCH

A geological-time unit longer than an age and a subdivision of a period.

ESKERS

Eskers are narrow, sinuous ridges of sand and gravel. They vary greatly in size. Many eskers consist of a central core of poorly sorted and stratified gravel. The core material is often draped by better sorted and stratified sand and gravel.

FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.074 mm). Also described informally as "dirt", these particles are in the silt- and clay-size range.

FLUVIAL

Pertaining to rivers or streams.

GLACIOFLUVIAL DEPOSITS

Material deposited by streams flowing from, on, or within melting glacier ice, generally composed of sorted, stratified sand and gravel; includes outwash, kame, esker, etc.

GLACIOLACUSTRINE DELTAS

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. Such deposits tend to consist mainly of sand and abundant silt. However, in near-ice or ice-contact positions, coarse material may be present.

GLACIOLACUSTRINE DEPOSITS

Material deposited in lakes affected by glacier ice or by meltwater flowing directly from glaciers; composed of well-sorted clay, silt, or sand.

GRANULAR BASE COURSE

Components of a road placed on subgrade and designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

GROUND MORAINE

A deposit of till with a flat or undulating surface.

HOLOCENE

An epoch of the Quaternary period covering the time period from the retreat of the continental glaciers to the present, about 10 000 years.

HUMMOCKY

An irregular or knob and kettle surface.

HUMMOCKY MORAINE

A landscape composed primarily of till with a hummocky surface.

ICE-CONTACT DEPOSIT

Material deposited in contact with glacier ice by meltwater; includes kames, eskers, kame terraces, etc.

ICE-CONTACT TERRACES

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure may be similar to outwash deposits.

KAMES

Kames are mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. The deposits consist mainly of irregularly bedded and cross-bedded, poorly sorted sand and gravel. Deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms.

LACUSTRINE DEPOSIT

Material deposited in a lake.

LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

MELTWATER CHANNEL

A drainage way produced by water flowing away from a melting glacier margin.

MORAINE

A distinct accumulation of glacial drift. Could represent an ice marginal position.

OUTWASH

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the ice lobes. They occur as sheets or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain-size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure.

PIT RUN

Unprocessed aggregate removed from pit. Generally consists of fine pebble gravel with minor amounts of material coarser than 38 mm (1 1/2"). It is used for road maintenance, upgrading and resurfacing.

PLEISTOCENE

An epoch of the recent geological past including the time from approximately 1.8 million years ago to 10 000 years ago. Much of the Pleistocene was characterized by extensive glacial activity.

QUATERNARY

The second period of the Cenozoic era, thought to cover the last 2-3 million years. It consists of two epochs: The Pleistocene and the Holocene.

RESOURCE

An aggregate deposit or environment which may or may not be proven and is presently not economically significant.

SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, siltstone, and mudstone.

SPILLWAY

Large drainage valley formed by meltwater flowing from a glacial lake. Spillways often have gravel terraces.

STONE

That component of aggregate coarser than 4.76 mm or the #4 sieve, includes pebbles, cobbles and boulders.

SURFICIAL GEOLOGY

A form of geological mapping dealing with all materials occurring at surface in an area: unlithified or lithified (sediments or bedrock).

TERRACE

A relatively flat, stair-stepped, depositional or erosional surface bounded by an ascending slope on one side and a descending slope on the other.

TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100 000 years ago and ended approximately 10 000 years ago. The glacial deposits and landforms of southern Manitoba are predominantly the result of glacial activity during the Winsconsinan Stage.

MAPS
NOT
FILMED

CARTES
OMISES